

What is Claimed is:

1. A microcapsule comprising a shell and a core enclosed in the shell, the core comprising a phase-change material and a nucleating agent for the phase-change material, the phase-change material comprising a paraffinic hydrocarbon, the nucleating agent comprising an organic compound miscible with the paraffinic hydrocarbon and having a melting point substantially higher than that of the paraffinic hydrocarbon, wherein the number of carbon atoms in the organic compound is greater than that of the paraffinic hydrocarbon.
2. The microcapsule of Claim 1, wherein the paraffinic hydrocarbon has the melting point of about 20°C or higher.
3. The microcapsule of Claim 1, wherein the paraffinic hydrocarbon is an unsubstituted paraffinic hydrocarbon.
4. The microcapsule of Claim 1, wherein the melting point of the organic compound is higher than that of the paraffinic hydrocarbon by at least about 10°C.
5. The microcapsule of Claim 1, wherein the melting point of the organic compound is higher than that of the paraffinic hydrocarbon by at least about 20°C.
6. The microcapsule of Claim 1, wherein the melting point of the organic compound is higher than that of the paraffinic hydrocarbon by at least about 25°C.
7. The microcapsule of Claim 1, wherein the organic compound comprises a portion that is substantially structurally similar to the paraffinic hydrocarbon of the phase-change material.
8. The microcapsule of Claim 1, wherein the paraffinic hydrocarbon is a linear chain hydrocarbon.
9. The microcapsule of Claim 1, wherein the organic compound is a substituted linear chain paraffinic hydrocarbon.
10. The microcapsule of Claim 1, wherein the paraffinic hydrocarbon and the organic compound are saturated hydrocarbons.
11. The microcapsule of Claim 1, wherein the organic compound is a paraffinic hydrocarbon substituted with one or more substituent groups selected from the group consisting of halo; hydroxyl; mercapto; cyano; amine; nitro; carboxyl; formyl; substituted or unsubstituted C1-C20 alkyl; substituted or unsubstituted C2-C10 alkenyl; substituted or

unsubstituted C2-C7 alkynyl; substituted or unsubstituted aryl; substituted or unsubstituted heteroaryl; substituted or unsubstituted C3-C7 cycloalkyl, in which a carbon atom in the ring can optionally be replaced by an oxygen, nitrogen or sulfur atom; substituted or unsubstituted C4-C7 cycloalkenyl, in which a carbon atom in the ring can be optionally replaced by an oxygen, nitrogen or sulfur atom; substituted or unsubstituted C1-C20 alkoxy; substituted or unsubstituted C2-C10 alkenyloxy; substituted or unsubstituted C2-C7 alkynyloxy; substituted or unsubstituted aryloxy; substituted or unsubstituted C1-C20 alkylamine; substituted or unsubstituted C2-C10 alkenylamine; substituted or unsubstituted C2-C7 alkynylamine; substituted or unsubstituted arylamine; substituted or unsubstituted alkylarylamine; substituted or unsubstituted C1-C20 alkylsilyl; substituted or unsubstituted C2-C10 alkenylsilyl; substituted or unsubstituted C2-C7 alkynylsilyl; substituted or unsubstituted arylsilyl; substituted or unsubstituted alkylarylsilyl; substituted or unsubstituted C1-C20 alkylboranyl; substituted or unsubstituted C2-C10 alkenylboranyl; substituted or unsubstituted C2-C7 alkynylboranyl; substituted or unsubstituted arylboranyl; substituted or unsubstituted alkylarylboranyl; substituted or unsubstituted C1-C20 alkylthio; substituted or unsubstituted C2-C10 alkenylthio; substituted or unsubstituted C2-C7 alkynylthio; and substituted or unsubstituted arylthio groups.

12. The microcapsule of Claim 1, wherein the organic compound is a paraffinic hydrocarbon substituted with one or more substituent groups selected from the group consisting of hydroxyl, amine and carboxyl.

13. The microcapsule of Claim 1, wherein the paraffinic hydrocarbon is a C13-C28 alkane.

14. The microcapsule of Claim 1, wherein the organic compound is a C14-C35 alkane substituted with one or more substituent groups.

15. The microcapsule of Claim 1, wherein the paraffinic hydrocarbon is selected from the group consisting of n-octacosane, n-heptacosane, n-hexacosane, n-pentacosane, n-tetracosane, n-tricosane, n-docosane, n-heneicosane, n-eicosane, n-nonadecane, n-octadecane, n-heptadecane, n-hexadecane, n-pentadecane, n-tetradecane and n-tridecane.

16. The microcapsule of Claim 1, wherein the organic compound is selected

from the group consisting of 1-octacosanol, 1-heptacosanol, 1-hexacosanol, 1-pentacosanol, 1-tetracosanol, 1-tricosanol, 1-docosanol, 1-heneicosanol, 1-eicosanol, 1-nonadecanol, 1-octadecanol, 1-heptadecanol, 1-hexadecanol, 1-pentadecanol, 1-tetradecanol, and 1-tridecanol.

17. The microcapsule of Claim 1, wherein the phase-change material further comprises at least one additional paraffinic hydrocarbon.

18. The microcapsule of Claim 17, wherein the number of carbon atoms in the additional paraffinic hydrocarbon is fewer than the number of carbon atoms of the organic compound.

19. The microcapsule of Claim 1, wherein the core has a diameter from about 0.1 μm to about 1,000 μm .

20. The microcapsule of Claim 1, wherein the core has a diameter from about 0.1 μm to about 100 μm .

21. The microcapsule of Claim 1, wherein the core has a diameter from about 1 μm to about 30 μm .

22. The microcapsule of Claim 1, wherein the diameter is from about 2 μm to about 10 μm .

23. The microcapsule of Claim 1, wherein the nucleating agent is from about 0.1 % to about 15 % with respect to the weight of the phase-change material.

24. The microcapsule of Claim 1, wherein the nucleating agent is from about 1 % to about 10 % with respect to the weight of the phase-change material.

25. The microcapsule of Claim 1, wherein the nucleating agent is from about 2.5 % to about 7.5 % with respect to the weight of the phase-change material.

26. The microcapsule of Claim 1, wherein the microcapsule has a melting onset temperature at which the core begins to melt and a solidifying onset temperature at which the core begins to solidify, and wherein the solidifying onset temperature is higher than the melting onset temperature.

27. The microcapsule of Claim 26, wherein the solidifying onset temperature is higher than the melting onset temperature by a temperature difference from about 0.1°C to about 10°C.

28. The microcapsule of Claim 26, wherein the solidifying onset temperature is higher than the melting onset temperature by a temperature difference from about 0.5°C to about 5°C.
29. The microcapsule of Claim 1, wherein the shell comprises a polymeric material.
30. A composition comprising a plurality of the microcapsules of Claim 1.
31. The composition of Claim 30, wherein the composition is in a form of powder, liquid or solid.
32. The composition of Claim 30, wherein the microcapsules are mixed with another material, and wherein the microcapsules form a discrete phase in a continuous phase of the other material.
33. The composition of Claim 30, wherein the microcapsules are in an amount from about 0.5 % to about 95 % of the total weight of the composition.
34. The composition of Claim 30, wherein the microcapsules are in an amount from about 5 % to about 90 % of the total weight of the composition.
35. The composition of Claim 30, wherein the microcapsules are in an amount from about 10 % to about 80 % of the total weight of the composition.
36. The composition of Claim 30, wherein the composition forms a fabric or fiber.
37. The composition of Claim 30, wherein the composition forms a flooring material.
38. A method of using the microcapsule of Claim 1, the method comprising:
 providing a composition comprising the microcapsule, wherein the composition is a powder, liquid or solid;
 mixing the composition with a material; and
 forming an article with the mixture.
39. A method of using the microcapsule of Claim 1, the method comprising:
 providing a liquid composition comprising the microcapsule;
 providing an article; and
 applying the liquid composition on a surface of the article.

40. A microcapsule comprising a shell and a core encapsulated by the shell, the core comprising a phase-change material and a nucleating agent for the phase-change material, wherein the microcapsule has a melting onset temperature at which the core begins to melt and a solidifying onset temperature at which the core begins to solidify, and wherein the solidifying onset temperature is higher than the melting onset temperature.

41. The microcapsule of Claim 40, wherein the core has a diameter from about 0.1 μm to about 100 μm .

42. The microcapsule of Claim 40, wherein the phase-change material comprises a C13-C28 alkane.

43. The microcapsule of Claim 40, wherein the nucleating agent comprises a C13-C35 alkane substituted with one or more substituent groups selected from the group consisting of hydroxyl, amine and carboxyl.

44. The microcapsule of Claim 40, wherein the phase-change material comprises an unsubstituted paraffinic hydrocarbon, wherein the nucleating agent comprises a substituted paraffinic hydrocarbon, and wherein the number of carbon atoms of the unsubstituted paraffinic hydrocarbon is fewer than that of the substituted paraffinic hydrocarbon.

45. The microcapsule of Claim 40, wherein the nucleating agent is from about 0.1 % to about 15 % with respect to the weight of the phase-change material.

46. The microcapsule of Claim 40, wherein the solidifying onset temperature is higher than the melting onset temperature by a temperature difference from about 0.5°C to about 5°C.

47. The microcapsule of Claim 40, wherein the phase-change material comprises a paraffinic hydrocarbon, wherein the nucleating agent comprises an organic compound miscible with the paraffinic hydrocarbon and having a melting point substantially higher than that of the paraffinic hydrocarbon, and wherein the number of carbon atoms in the organic compound is greater than that of the paraffinic hydrocarbon.

48. The microcapsule of Claim 47, wherein the melting point of the organic compound is higher than that of the paraffinic hydrocarbon by at least about 10°C.

49. The microcapsule of Claim 47, wherein the organic compound comprises a

portion that is substantially structurally similar to the paraffinic hydrocarbon of the phase-change material.

50. The microcapsule of Claim 40, wherein the microcapsule has a melting peak temperature and a solidifying peak temperature, wherein at the melting peak temperature the core is melting with the most latent heat absorption, wherein at the solidifying peak temperature the core is solidifying with the most latent heat release, and wherein a difference between the melting peak temperature and the solidifying peak temperature is not greater than about 20°C.

51. The microcapsule of Claim 50, wherein the difference is not greater than about 15°C.

52. The microcapsule of Claim 50, wherein the difference is not greater than about 13°C.

53. The microcapsule of Claim 40, wherein the microcapsule has a solidifying peak temperature, at which the core is solidifying with the most latent heat release from the core, and wherein a difference between the melting onset temperature and the solidifying peak temperature is not greater than about 10°C.

54. The microcapsule of Claim 53, wherein the difference is not greater than about 6°C.

55. A composition comprising a plurality of the microcapsules of Claim 40.

56. The composition of Claim 55, wherein the composition is in the form of a powder, liquid or solid.

57. A method of using the microcapsule of Claim 40, the method comprising:
providing a composition comprising the microcapsule, wherein the composition is a powder, liquid or solid;
mixing the composition with a material; and
forming an article with the mixture.

58. A method of using the microcapsule of Claim 40, the method comprising:
providing a liquid composition comprising the microcapsule;
providing an article; and
applying the liquid composition on a surface of the article.

59. A microcapsule comprising a shell and a core enclosed in the shell, the core comprising a phase-change material and means for increasing a solidifying onset temperature beyond a melting onset temperature of the core, wherein the melting onset temperature is the temperature at which the core begins to melt, and wherein the solidifying onset temperature is the temperature at which the core begins to solidify.

60. The microcapsule of Claim 59, wherein the core has a diameter from about 0.1 μm to about 100 μm .

61. The microcapsule of Claim 59, wherein the core has a diameter from about 1 μm to about 30 μm .

62. The microcapsule of Claim 59, wherein the solidifying onset temperature is higher than the melting onset temperature by a difference from about 0.1°C to about 10°C.

63. The microcapsule of Claim 59, wherein the solidifying onset temperature is higher than the melting onset temperature by a difference from about 0.5°C to about 5°C.

64. The microcapsule of Claim 59, wherein the microcapsule has a solidifying peak temperature, at which the core is solidifying with the most latent heat release from the core, and wherein a difference between the melting onset temperature and the solidifying peak temperature is not greater than about 10°C.

65. The microcapsule of Claim 64, wherein the difference is not greater than about 6°C.